U.S. FISH AND WILDLIFE SERVICE
SPECIES ASSESSMENT AND LISTING PRIORITY ASSIGNMENT FORM

SCIENTIFIC NAME: *Chamaesyce remyi* var. *kauaiensis*

COMMON NAME: `Akoko

LEAD REGION: Region 1

INFORMATION CURRENT AS OF: July 2005

STATUS/ACTION:

___ Species assessment - determined species did not meet the definition of endangered or threatened under the Act and, therefore, was not elevated to Candidate status

___ New candidate

_X_ Continuing candidate

___ Non-petitioned

_X_ Petitioned - Date petition received: May 11, 2004

_ 90-day positive - FR date:

_X_ 12-month warranted but precluded - FR date: May 11, 2005

_N_ Did the petition request a reclassification of a listed species?

FOR PETITIONED CANDIDATE SPECIES:

a. Is listing warranted (if yes, see summary of threats below)? yes

b. To date, has publication of a proposal to list been precluded by other higher priority listing actions? yes

c. If the answer to a. and b. is "yes", provide an explanation of why the action is precluded. We find that the immediate issuance of a proposed rule and timely promulgation of a final rule for this species has been, for the preceding 12 months, and continues to be, precluded by higher priority listing actions. During the past 12 months, most of our national listing budget has been consumed by work on various listing actions to comply with court orders and court-approved settlement agreements, meeting statutory deadlines for petition findings or listing determinations, emergency listing evaluations and determinations and essential litigation-related, administrative, and program management tasks. We will continue to monitor the status of this species as new information becomes available. This review will determine if a change in status is warranted, including the need to make prompt use of emergency listing procedures. For information on listing actions taken over the past 12 months, see the discussion of "Progress on Revising the Lists," in the current CNOR which can be viewed on our Internet website (http://endangered.fws.gov).

_ _ Listing priority change

Former LP: ___

New LP: ___

Date when the species first became a Candidate (as currently defined): 1990

___ Candidate removal: Former LP: __

___ A – Taxon is more abundant or widespread than previously believed or not subject to the degree of threats sufficient to warrant issuance of a proposed listing or

continuance of candidate status.

___U – Taxon not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status due, in part or totally, to conservation efforts that remove or reduce the threats to the species.

___ F – Range is no longer a U.S. territory.

___ I – Insufficient information exists on biological vulnerability and threats to support listing.

___ M – Taxon mistakenly included in past notice of review.

___ N – Taxon does not meet the Act's definition of "species."

___ X – Taxon believed to be extinct.

ANIMAL/PLANT GROUP AND FAMILY: Flowering plants, Euphorbiaceae (Spurge family)

HISTORICAL STATES/TERRITORIES/COUNTRIES OF OCCURRENCE: Hawaii, island of Kauai

CURRENT STATES/ COUNTIES/TERRITORIES/COUNTRIES OF OCCURRENCE: Hawaii, island of Kauai

LAND OWNERSHIP: Populations are found on State and private lands.

LEAD REGION CONTACT: Paul Phifer, 503-872-2823, paul_phifer@fws.gov

LEAD FIELD OFFICE CONTACT: Pacific Islands Fish & Wildlife Office, Christa Russell, 808-792-9400, christa_russell@fws.gov

BIOLOGICAL INFORMATION:

Species Description *Chamaesyce remyi* var. *kauaiensis* is a shrub; stems erect to scandent, 0.3 to 2 meters (1.0 to 6.6 feet) long, flowering branches 1 to 6 millimeters (0.04 to 0.24 inches) in diameter. Leaves are oppositely arranged with each succeeding pair set at right angles to the preceeding pair, are elliptic to oblong or broadly lanceolate in shape, 35 to 165 millimeters (1.4 to 6.5 inches) long, and 15 to 75 millimeters (0.6 to 3 inches) wide. This variety has many-branched cymose inflorescences and glabrous capsules scarcely protruding beyond the top of the cyathia (Koutnik 1999).

Taxonomy *Chamaesyce remyi* var. *kauaiensis* was originally described by Degener and Sherff as *Euphorbia remyi* var. *kauaiensis.* It was later transferred to the genus *Chamaesyce* by O. Degener and I. Degener. This species is recognized as a distinct taxon by Koutnik (1999) and Wagner and Herbst (2003), the most recently accepted Hawaiian plant taxonomy.

Habitat *Chamaesyce remyi* var. *kauaiensis* is found in wind-swept shrubland and adjacent forest patches dominated by *Metrosideros* and *Syzygium* with the following associated taxa: *Antidesma platyphyllum, Broussaisia arguta, Cheirodendron fauriei, Cibotium nealiae, Dicranopteris linearis, Diplopterigium pinnatum, Machaerina angustifolia, M. mariscoide, Melicope feddei, M. waialealae, Odontosoria chinensis, Psychotria hexandra, P. mariniana, P. wawraea, Sadleria pallida,* and *Scaevola gaudichaudiana,* in rich brown soil with silty clay, and at

elevations between 671 to 732 meters (2,200 to 2,400 feet) (Ken Wood, National Tropical Botanical Garden, pers. comm. 2000). *Chamaesyce remyi* var. kauaiensis is also found on stream walls or stream confluence flats on rocky saturated soil, in *Metrosideros polymorpha* lowland wet forest with *Cyanea* sp., *Cyrtandra* sp., *Diplazium* sp., *Perrottetia sandwicensis*, and other ferns, and at elevations between 183 to 780 m (2,200 to 2,400 ft) (Hawaii Natural Heritage Program Database 2004).

Historical and Current Range/Current Status *Chamaesyce remyi* var. *kauaiensis* is historically known from four or five populations totaling 300 to 400 individuals (Dave Lorence and Ken Wood, National Tropical Botanical Garden, pers. comms. 1996). This variety was found only in the Wahiawa and Blue Hole areas on the island of Kauai (Koutnik 1999). Based on additional surveys conducted from 2000 through 2004, the taxon is now known from five populations totaling approximately 800 to 1,000 individuals in Blue Hole, Lumahai Valley, Wainiha, and Iliiliula (K. Wood, pers. comm. 2005).

THREATS:

A. The present or threatened destruction, modification, or curtailment of its habitat or range. *Chamaesyce remyi* var. *kauaiensis* is threatened by feral goats (*Capra hircus*) and pigs (*Sus scrofa*) (Steve Perlman and K. Wood, pers. comms. 1996). As early as 1778, European explorers introduced livestock, which became feral, increased in number and range, and caused significant changes to the natural environment of Hawaii. Past and present activities of introduced alien mammals are the primary factor altering and degrading vegetation and habitat on Kauai. Feral ungulates trample and eat native vegetation and disturb and open areas. This causes erosion and allows the entry of alien plant species (Cuddihy and Stone 1990; Wagner *et al*. 1999a).

The goat, a species originally native to the Middle East and India, was successfully introduced to the Hawaiian Islands in 1792. Currently, populations exist on Kauai, Oahu, Maui, and Hawaii. On Kauai, feral goats have been present in drier, more rugged areas since the 1820s and they still occur in Waimea Canyon and along the Na Pali Coast, as well as in the drier perimeter of Alakai Swamp and even in its wetter areas such as Wahiawa during periods with low rainfall. Goats browse on introduced grasses and native plants, especially in drier and more open ecosystems. Feral goats eat native vegetation, trample roots and seedlings, cause erosion, and promote the invasion of alien plants. They are able to forage in extremely rugged terrain and have a high reproductive capacity (Clarke and Cuddihy 1980; van Riper and van Riper 1982; Scott *et al*. 1986; Tomich 1986; Culliney 1988; Cuddihy and Stone 1990). The mesic and dry habitats were damaged in the past by goats, and these effects are still apparent in the form of alien vegetation and erosion. This species is threatened by direct damage from feral goats, such as browsing, trampling of plants and seedlings, and erosion of substrate (Clarke and Cuddihy 1980; van Riper and van Riper 1982; Scott *et al*. 1986; Culliney 1988).

The pig is originally native to Europe, northern Africa, Asia Minor, and Asia. European pigs, introduced to Hawaii by Captain James Cook in 1778, became feral and invaded forested areas, especially wet and mesic forests and dry areas at high elevations. They are currently present on Kauai and four other islands, and inhabit rain forests and grasslands. While rooting in the ground in search of the invertebrates and plant material they eat, feral pigs disturb and destroy vegetative cover, trample plants and seedlings, and threaten forest regeneration by damaging

seeds and seedlings. They disturb soil and cause erosion, especially on slopes. Alien plant seeds are dispersed on their hooves and coats as well as through their digestive tracts, and the disturbed soil is fertilized by their feces, helping these plants to establish. Pigs are a major vector in the spread of many introduced plant species (Smith 1985; Stone 1985; Medeiros *et al*. 1986; Scott *et al*. 1986; Tomich 1986; Cuddihy and Stone 1990; Wagner *et al*. 1999a).

Pig and goat exclusion fences protect two of the five known populations of this species; however, without continued monitoring and maintenance of those fences, pigs from surrounding areas can easily access fenced areas. In addition, the remaining, unfenced individuals of this taxon are still impacted by feral pigs and goats.

B. Overutilization for commercial, recreational, scientific, or educational purposes.
None known.

C. Disease or predation.
Minor damage has been observed from an introduced insect, the two-spotted leafhopper (*Sophonia rufofascia*) (K. Wood, pers. comm. 1996). The two-spotted leafhopper causes feeding damage on leaves, typically in the form of stippling and yellowing. In addition to mechanical feeding damage, this insect may introduce a plant virus. It is suspected of causing severe dieback of the native fern *Dicranopteris linearis* (uluhe) and economic damage to crops and ornamental plants in Hawaii (Adam Asquith, U.S. Fish and Wildlife Service (Service), pers. comm. 1994).

D. The inadequacy of existing regulatory mechanisms.
Pigs and goats are managed in Hawaii as game animals but may populate inaccessible areas where hunting is difficult, if not impossible, and therefore has little effect on their numbers (Hawaii Heritage Program 1990). Pig and goat hunting is allowed on all islands either year-round or during certain months, depending on the area (Hawaii Department of Land and Natural Resources n.d.-a, n.d.-b, n.d.-c, n.d.-d). However, public hunting does not adequately control the number of goats and pigs to eliminate this threat to *Chamaesyce remyi* var. *kauaiensis*. Pig and goat exclusion fences protect two of the five known populations of this species; however, without continued monitoring and maintenance of those fences, pigs and goats from surrounding areas can easily access fenced areas. In addition, the remaining, unfenced individuals of this taxon are still impacted by these feral ungulates.

E. Other natural or manmade factors affecting its continued existence.
Alien plant species threaten this species (K. Wood, pers. comm. 2000). Although the exact pest species that threaten this plant have not been identified, alien pest plants are found throughout the areas where this species occurs. The original native flora of Hawaii consisted of about 1,400 species, nearly 90 percent of which were endemic. Of the total native and naturalized Hawaiian flora of 1,817 taxa, 47 percent were introduced from other parts of the world, and nearly 100 species have become pests (Smith 1985; Wagner *et al*. 1999a). Confirmed personal observations (K. Wood, pers. comm. 2000) and several studies (Cuddihy and Stone 1990; Wood and Perlman 1997; Robichaux *et al*. 1998) indicate nonnative plant species may outcompete native plants similar to *Chamaesyce remyi* var. *kauaiensis*. Competition may be for space, light, water, or nutrients, or there may be a chemical inhibition of other plants (Smith 1985; Cuddihy and Stone

1990). In addition, nonnative pest plants found in habitat similar to that of this species have been shown to make the habitat less suitable for native species (Smathers and Gardner 1978; Smith 1985; Loope and Medeiros 1992; Medeiros *et al.* 1992; Ellshoff *et al.* 1995; Meyer and Florence 1996; Medeiros *et al.* 1997; Loope *et al*. 2004). In particular, alien pest plant species modify habitat by modifying availability of light, altering soil-water regimes, modifying nutrient cycling, or altering fire characteristics of native plant communities (Smith 1985; Cuddihy and Stone 1990; Vitousek *et al*. 1987). Because of demonstrated habitat modification and resource competition by nonnative plant species in habitat similar to the wind-swept shrubland and adjacent forest patches dominated by *Metrosideros* and *Syzygium* habitat of *C. remyi* var. *kauaiensis*, the Service believes nonnative plant species are a threat to *C. remyi* var. *kauaiensis*. Nonnative plants are being controlled in two of the five known populations of this species, but will probably never be completely eradicated because new propagules are constantly being dispersed into the fenced area from surrounding, unmanaged lands. Currently, many widespread alien plant taxa cannot be completely eradicated from Kauai, and therefore are expected to continue dispersing into previously managed areas (Loope 1998, Smith 1985). The remaining unmanaged populations of *C. remyi* var. *kauaiensis* are still impacted by this threat.

CONSERVATION MEASURES PLANNED OR IMPLEMENTED

The Service has provided funding to the Waipa Foundation, a non-profit grassroots community organization on Kauai, and work has begun on riparian and coastal restoration at four sites within Lumahai Valley. The riparian site(s) will provide protection to *Chamaesyce remyi* ssp. *kauaiensis* and other rare plants, through weed control and outplanting (The Nature Conservancy 2005a). The Service has also provided funding to The Nature Conservancy for fencing and weed control of Wahiawa Bog, which will benefit this species (The Nature Conservancy 2005b).

SUMMARY OF THREATS

The major threats to this taxon are pigs, goats, and nonnative plants. Feral pigs and goats have been fenced out of two of five populations where *Chamaesyce remyi* var. *kauaiensis* currently occurs, but the fences must be continually maintained to prevent incursion. Nonnative plants have been greatly reduced in the two populations that are fenced. The unmanaged populations are impacted by these threats and all populations are threatened by the two-spotted leafhopper as there are no effective control methods in place. Long-term monitoring and management to maintain threat free areas will be required.

LISTING PRIORITY:

THREAT			
Magnitude	Immediacy	Taxonomy	Priority
High	**Imminent**	Monotypic genus	1
		Species	2
		Subspecies/population	**3***
	Non-imminent	Monotypic genus	4
		Species	5
		Subspecies/population	6

Moderate to Low	Imminent	Monotypic genus	7
		Species	8
		Subspecies/population	9
	Non-imminent	Monotypic genus	10
		Species	11
		Subspecies/population	12

Rationale for listing priority number:

Magnitude:
This species is highly threatened by goats and pigs that degrade and destroy habitat; by the nonnative two-spotted leafhopper that damages leaves and may spread plant viruses; and by nonnative plants that outcompete and displace it. Threats to lowland shrubland and wet forest habitat of *Chamaesyce remyi* var. *kauaiensis* and to individuals of this species occur throughout its range, and are expected to continue or increase without their control or eradication. Ungulates and nonnative plants are being controlled in two of the five known populations of this species. Without continued monitoring and maintenance of those fences, pigs from surrounding areas can easily access fenced areas. Nonnative plants will probably never be completely eradicated because new propagules are constantly being dispersed into the fenced areas from surrounding, unmanaged lands. In addition, the remaining, unfenced individuals of this taxon are still impacted by these threats.

Imminence:
Threats to *Chamaesyce remyi* var. *kauaiensis* from goats, pigs, and nonnative plants are imminent because they are ongoing in three of the five known populations. In addition, the two-spotted leafhopper threatens all five populations.

Yes Have you promptly reviewed all of the information received regarding the species for the purpose of determining whether emergency listing is needed?

Is Emergency Listing Warranted?
No. The species does not appear to be appropriate for emergency listing at this time because the immediacy of the threats is not so great as to imperil a significant proportion of the taxon within the time frame of the routine listing process. In addition, two populations are fenced from ungulates and nonnative plant control is ongoing, and the Service has provided funding to a community organization for riparian and coastal restoration in an area where one of the populations occurs. This effort will benefit *Chamaesyce remyi* ssp. *kauaiensis* through propagation and augmentation of existing populations. If it becomes apparent that the routine listing process is not sufficient to prevent large losses that may result in this species' extinction, then the emergency rule process for this species will be initiated. We will continue to monitor the status of *C. remyi* var. *kauaiensis* as new information becomes available. This review will determine if a change in status is warranted, including the need to make prompt use of emergency listing procedures.

DESCRIPTION OF MONITORING:

Much of the information in this form is based on the results of a meeting of 20 botanical experts held by the Center for Plant Conservation in December of 1995, and has been updated by personal communication with David Lorence and Ken Wood of National Tropical Botanical Garden. We have incorporated additional information on this species from our files, including personal communications with Steve Perlman, National Tropical Botanical Garden in 1996; Ken Wood, National Tropical Botanical Garden in 1996, 2000, and 2005; Dave Lorence, National Tropical Botanical Garden in 1996, and Adam Asquith, Service in 1994. In addition, we have included the most recent supplement to the *Manual of the Flowering Plants of Hawaii* (Wagner and Herbst 2003). In 2004 the Pacific Islands office contacted the following species experts: Bob Hobdy, retired from Hawaii Division of Forestry and Wildlife; Joel Lau, Hawaii Natural Heritage Program; Art Medeiros, U.S.G.S. Biological Resources Discipline; Hank Oppenheimer, resource manager for Maui Land and Pineapple Company; and Steve Perlman, National Tropical Botanical Garden. No new information was provided by these individuals and they were not able to clarify the current status of these plants. In 2005 we contacted the species experts listed below and Ken Wood, National Tropical Botanical Garden, provided information from surveys conducted from 2000 through 2004.

The Hawaii Natural Heritage Program listed this species as critically imperiled (Hawaii Natural Heritage Program Database 2004). Based on the International Union for Conservation of Nature and Natural Resources Red Plant Data Book rarity categories, this species is recognized as Rare (could be considered at risk) by Wagner *et al.* (1999b).

One species expert has provided new information confirming the status of the species this year and the results are included in this assessment.

COORDINATION WITH STATES

In October 2004 we provided the Hawaii Division of Forestry and Wildlife with copies of our most recent candidate assessments for their review and comment. Vickie Caraway, the State botanist, reviewed the information for *Chamaesyce remyi* var. *kauaiensis* and suggested that this taxon may meet the interim recovery objectives for Hawaiian plants, and therefore may not warrant listing. The interim recovery objectives for a short-lived species such as this taxon are aimed at stabilizing the species and preventing extinction in the near future, and include 1) the existence of 3 populations of 50 reproducing individuals each, 2) all threats managed and, 3) the species in genetic storage. While the population numbers may meet the interim recovery objectives, the threats to this variety are being controlled in only two of the five populations. In addition, this variety is not currently in genetic storage. Therefore, we believe listing is warranted for *C. remyi* var. *kauaiensis.*

LITERATURE CITED

List all experts contacted:

Name	Date	Place of Employment
1. Joel Lau	June 28, 2005	Hawaii Natural Heritage Program
2. Art Medeiros	June 28, 2005	U.S.G.S. Biological Resources Discipline
3. Jim Jacobi	June 28, 2005	U.S.G.S. Biological Resources Discipline
4. Rick Warshauer	June 28, 2005	U.S.G.S. Biological Resources Discipline

5.	Hank Oppenheimer	June 28, 2005	Maui Land and Pineapple Company
6.	Kapua Kawelo	June 28, 2005	U.S. Army
7.	Dave Lorence	June 28, 2005	National Tropical Botanical Garden
8.	Steve Perlman	June 28, 2005	National Tropical Botanical Garden
9.	Ken Wood*	June 28, 2005	National Tropical Botanical Garden
10.	Vickie Caraway	June 14, 2005	Hawaii Division of Forestry and Wildlife

*Provided new information on this taxon in 2005

List all databases utilized:

Name	Date
1. Hawaii Natural Heritage Program	2004

Other resources searched:

Center for Biological Diversity, Dr. Jane Goodall, Dr. E.O. Wilson, Dr. Paul Ehrlich, Dr. John Terborgh, Dr. Niles Eldridge, Dr. Thomas Eisner, Dr. Robert Hass, Barbara Kingsolver, Charles Bowden, Martin Sheen, the Xerces Society, and the Biodiversity Conservation Alliance. 2004. Hawaiian Plants: petitions to list as federally endangered species. May 4, 2004.

Clarke, G., and L.W. Cuddihy. 1980. A botanical reconnaissance of the Na Pali coast trail: Kee Beach to Kalalau Valley (April 9-11, 1980). Division of Forestry and Wildlife, Department of Land and Natural Resources, Hilo, Hawaii.

Cuddihy, L.W., and C.P. Stone. 1990. Alteration of native Hawaiian vegetation; effects of humans, their activities and introductions. Coop. Natl. Park Resources Stud. Unit, Hawaii. 138 pp.

Culliney, J.L. 1988. Islands in a Far Sea; Nature and Man in Hawaii. Sierra Club Books, San Francisco. 410 pp.

Ellshoff, Z.E., D.E. Gardner, C. Wikler, and C.W. Smith. 1995. Annotated bibliography of the genus *Psidium*, with emphasis on *P. cattleianum* (strawberry guava) and *P. guajava* (common guava), forest weeds in Hawai`i. Cooperative National Park Resources Studies Unit, University of Hawaii. Technical Report 95.

Hawaii, Department of Land and Natural Resources. N.d.-a. Summary of Title 13, Chapter 123, Game mammal hunting rules, island of Oahu. Division of Forestry and Wildlife, Honolulu. 2 pp.

Hawaii, Department of Land and Natural Resources. N.d.-b. Summary of Title 13, Chapter 123, Game mammal hunting rules, island of Molokai. Division of Forestry and Wildlife, Honolulu. 2 pp.

Hawaii, Department of Land and Natural Resources. N.d.-c. Summary of Title 13, Chapter 123, Game mammal hunting rules, island of Maui. Division of Forestry and Wildlife, Honolulu. 2 pp.

Hawaii, Department of Land and Natural Resources. N.d.-d. Summary of Title 13, Chapter 123, Game mammal hunting rules, island of Kauai. Division of Forestry and Wildlife, Honolulu.

Hawaii Heritage Program, The Nature Conservancy of Hawaii. 1990. Management recommendations for Na Pali Coast State Park, island of Kauai. Unpublished report prepared for Hawaii, Department of Land and Natural Resources, Division of State Parks, Honolulu. 18 pp.

Koutnik, D.L. 1999. *Chamaesyce*: *in* Wagner, W.L., D.R. Herbst, and S.H. Sohmer, Manual of the Flowering Plants of Hawai'i. University of Hawaii Press and Bishop Museum Press, Honolulu. Bishop Mus. Spec. Publ. 97: 602-617.

Loope, L.L. and A.C. Medeiros. 1992. A new and invasive grass on Maui. Newsletter of the Hawaiian Botanical Society 31: 7-8.

Loope, L.L. 1998. Hawaii and Pacific Islands. Pp. 747-774. In: M.J. Mac, P.A. Opler, C.E. Puckett Haecker, and P.D. Doran (eds.). Status and Trends of the Nation's Biological Resources, Volume 2. U.S. Department of the Interior, U.S. Geological Survey, Reston, VA.

Loope, L., F. Starr and K. Starr. 2004. Management and research for protecting endangered Hawaiian plant species from displacement by invasive plants on Maui, Hawaii. Weed Technology 18: 1472-1474.

Medeiros, A.C., Jr., L.L. Loope, and R.A. Holt. 1986. Status of native flowering plant species on the south slope of Haleakala, East Maui, Hawaii. Coop. Natl. Park Resources Stud. Unit, Hawaii, Techn. Rept. 59:1-230.

Medeiros, A.C., L.L. Loope, P. Conant and S. McElvaney. 1997. Status, ecology, and management of the invasive plant, *Miconia calvescens* DC (Melastomataceae) in the Hawaiian Islands. Bishop Mus. Occas. Pap.48: 23-36.

Medeiros, A.C., L.L. Loope, T. Flynn, S.J. Anderson, L.W. Cuddihy, and K.A. Wilson. 1992. Notes on the status of an invasive Australian tree fern (*Cyathea cooperi*) in Hawaiian rain forests. American Fern Journal 82: 27-33.

Meyer, J.-Y. and J. Florence. 1996. Tahiti's native flora endangered by the invasion of *Miconia calvescens* D.C. (Melastomataceae). Journal of Biogeography 23: 775-781.

Robichaux, R., J. Canfield, F. R. Warshauer, L. Perry, M. Bruegmann, and G. Carr. 1998. Adaptive Radiation. Endangered Species Bulletin. November/December.

Scott, J.M., S. Mountainspring, F.L. Ramsey, and C.B. Kepler. 1986. Forest bird communities of the Hawaiian Islands: Their dynamics, ecology, and conservation. Studies in Avian Biology 9:1-429. Cooper Ornithological Society, Los Angeles.

Smathers, G.A. and D.E. Gardner. 1978. Stand analysis of an invading firetree (*Myrica faya* Aiton) population, Hawai`i. Proceeding of the Second Conference on Natural Science, Hawaii Volcanoes National Park, pp. 274-288.

Smith, C.W. 1985. Impact of alien plants on Hawai`i's native biota: *In* Stone, C.P., and J.M. Scott (eds.), Hawai`i's Terrestrial Ecosystems: Preservation and Management. Coop. Natl. Park Resources Stud. Unit, Univ. Hawaii, Honolulu, pp. 180-250.

Stone, C.P. 1985. Alien animals in Hawai`i's native ecosystems: toward controlling the adverse effects of introduced vertebrates: *In* Stone, C.P., and J.M. Scott (eds.), Hawai'i's Terrestrial Ecosystems: Preservation and Management. Coop. Natl. Park Resources Stud. Unit, Univ. Hawaii, Honolulu, pp. 251-297.

The Nature Conservancy. 2005a. Invasive plant control in Lumahai Valley, Kauai, Hawaii: Annual progress report. Prepared for U.S. Fish and Wildlife Service, Honolulu. July, 2005.

The Nature Conservancy. 2005b. Kanaele Bog fence project. Proposal for extension of grant with U.S. Fish and Wildlife Service, Honolulu. June 1, 2005.

Tomich, P.Q. 1986. Mammals in Hawai`i: A synopsis and notational bibliography. Bishop Museum Press, Honolulu. 375 pp.

van Riper, S.G., and C. van Riper III. 1982. A field guide to the mammals in Hawaii. The

Oriental Publishing Company, Honolulu. 68 pp.
Vitousek, P.M., C.M. D'Antonio, L.L. Loope, M. Rejnanek, and R. Westerbrooks. 1997. Introduced species: a significant component of human-caused global change. New Zealand Journal of Ecology 21(1): 1-16.
Wagner, W.L., D.R. Herbst, and S.H. Sohmer. 1999a. Manual of the Flowering Plants of Hawai`i. University of Hawaii Press and Bishop Museum Press, Honolulu. Bishop Mus. Spec. Publ. 97: 1-1918.
Wagner, W.L., M.M. Bruegmann, and J.Q.C. Lau. 1999b. Hawaiian vascular plants at risk: 1999. Bishop Mus. Occas. Pap. 60: 1-58.
Wagner, W.L. and D.R. Herbst. 2003. Electronic supplement to the manual of flowering plants of Hawai‘i, version 3.1. December 12, 2003. Available from the Internet. URL: http://rathbun.si.edu/botany/pacificislandbiodiversity/hawaiianflora/supplement.htm.
Wenkam, R. 1969. Kauai and the park country of Hawaii. Sierra Club, San Francisco. 160 pp.
Wood, K.R. and S. Perlman. 1997. Maui 14 plant survey final report. Submitted by National Tropical Botanical Garden, October, 1997.

APPROVAL/CONCURRENCE: Lead Regions must obtain written concurrence from all other Regions within the range of the species before recommending changes to the candidate list, including listing priority changes; the Regional Director must approve all such recommendations. The Director must concur on all 12-month petition findings, additions of species to the candidate list, removal of candidate species, and listing priority changes.

Approve: Acting _____ 11/10/05
Regional Director, Fish and Wildlife Service Date

Concur: _____ August 23, 2006
Director, Fish and Wildlife Service Date

Do not concur: _____ _____
Director, Fish and Wildlife Service Date

Date of annual review: September 16, 2005
Conducted by: Marie M. Bruegmann, Pacific Islands FWO
Plant Recovery Coordinator

Comments:
PIFWO Review

Reviewed by: Christa Russell Date: September 19, 2005
Plant Conservation Program Leader

Gina Shultz Date: October 13, 2005
Assistant Field Supervisor,
Endangered Species

Patrick Leonard Date: October 13, 2005
Field Supervisor